

REMARKS

Claims 1-20 are all the claims presently pending in the application. Claims 1, 4-5 and 8 have been amended and claims 11-20 have been added to more clearly define the invention.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 1-4 stand rejected upon informalities (e.g., 35 U.S.C. § 112, second paragraph). Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Kern, "Handbook of Semiconductor wafer cleaning Technology". Claims 1-3 and 5-10 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Yamazaki et al. (U.S. Patent No. 4,987,008). Claim 4 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamazaki et al. in view of Kern.

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention, as recited in claim 1, is directed to a method for manufacturing a group III nitride compound semiconductor device. The method includes forming a resist layer on a group III nitride compound semiconductor layer, and irradiating a surface of the wafer with ultraviolet rays to thereby clean the surface of the wafer.

Conventional methods use either chemical treatment or O₂ plasma treatment (plasma ashing) to remove contaminants from a wafer surface (Application at page 2, line 8-page 3, line 12). However, these processes increase a driving voltage of the light-emitting device or cause a leakage current (Application at page 3, line 13-16).

The claimed invention, on the other hand, irradiates the surface of the wafer after patterning the resist layer. This feature is important for ensuring that the surface of the wafer is free of contaminants, such as an organic resist residue, after patterning the resist layer.

The claimed invention as recited in claim 8, is directed to a method for cleaning a group III nitride compound semiconductor device which includes cutting a wafer including a

group III nitride compound semiconductor layer to form a plurality of wafer chips, and after cutting the wafer, irradiating a surface of the plurality of wafer chips with ultraviolet rays to thereby clean the surface of the plurality of wafer chips.

Unlike conventional methods which use chemical or O₂ plasma to remove contaminants and, therefore, increase a driving voltage or a leakage current, the claimed invention irradiates the surface of the plurality of wafer chips after cutting the wafer. This feature is important for ensuring that the surface of the wafer is free of contaminants, such as an organic resist residue, after cutting the wafer.

II. THE 35 U.S.C. 112, SECOND PARAGRAPH REJECTION

The Examiner alleges that claims 1-4 are indefinite for failing to particularly point out and distinctly claim the subject matter of the invention. Applicant submits that claim 1 has been amended to address the Examiner's concerns.

For example, Applicant submits that claim 1 has been amended to recite at least "*forming a resist layer on a group III nitride compound semiconductor layer*". Therefore, contrary to the Examiner's allegations, claim 1 sufficiently defines a method for manufacturing a semiconductor device.

Therefore, Applicant submits that claims 1-4 are not indefinite.

III. THE PRIOR ART REFERENCE

A. The Kern Reference

The Examiner alleges that Kern teaches the claimed invention of claim 1. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Kern.

Kern discloses a ultraviolet (UV)/ozone cleaning method for cleaning semiconductor surfaces. Specifically, Kern discloses that UV light has the ability to depolymerize a variety of photoresist polymers (Kern at page 233, lines 19-20).

Applicant submits, however, that Kern does not teach or suggest "*wherein said irradiating said surface of said wafer is performed after said patterning said resist layer*" as recited in claim 1.

As explained in the present Application, conventional methods for manufacturing a

group III nitride compound semiconductor device use either a chemical treatment or an O₂ plasma treatment to clean a surface of the device (Application at page 2, line 19-page 4, line 3). However, such treatment often damage the layers of the semiconductor device (Application at page 2, lines 21-22; page 3, lines 6-8)

The claimed invention, on the other hand, irradiates a surface of the semiconductor device with ultraviolet (UV) rays after patterning a resist layer, to clean the semiconductor device (Application at page 4, lines 7-9; Figure 2). Unlike the conventional methods, in the claimed method, the UV rays effectively clean the surface without damaging the wafer (Application at page 4, lines 10-13).

For example, as shown in Figure 4 of the present Application, a patterned resist layer may include one or more windows. Thus, the surface of the wafer may be cleaned by irradiating the surface of the wafer through the window of the resist layer.

Clearly, these features are not taught or suggested by the cited references. Indeed, one object of the claimed method is to remove organic contaminations remaining after patterning a resist layer. However, nowhere does Kern even address this object of the claimed method.

In fact, Kern merely states that UV light has the capability of depolymerizing a variety of photoresist polymers. Kern discloses experiments that were conducted on “polished quartz wafers” (Kern at page 235, lines 11-12) and on an aluminum thin film (Kern at page 235, lines 25-26) and on silicon (Kern at page 252, lines 27-30). However, nowhere does Kern disclose or suggest a patterned resist layer, let alone irradiating a surface of a wafer after a resist layer has been patterned.

Therefore, the Kern method is completely different than the claimed invention which *irradiates a surface of the wafer after patterning a resist layer* as recited in claim 1.

Therefore, Applicant submits that there are elements of the claimed invention that are not taught or suggest by Kern.

B. The Yamazaki et al. Reference

The Examiner alleges that Yamazaki et al. teaches the invention of claims 1-3 and 5-10 and would have been combined with Kern to form the invention of claim 4. Applicant submits, however, that Yamazaki does not teach or suggest the claimed invention, and that Yamazaki would not have been combined with Kern and even if combined, the combination

would not teach or suggest each and every element of the claimed invention.

Yamazaki discloses a method of forming a film which is intended to avoid damage on the surface of semiconductor. The Yamazaki method includes generating an active halogen or active hydrogen by a photochemical reaction, and cleaning the surface of the semiconductor by removing oxide formed thereon by means of the active elements (Yamazaki at Abstract).

Applicant submits, however, that Yamazaki does not teach or suggest “*wherein said irradiating said surface of said wafer is performed after said patterning said resist layer*” as recited in claims 1 and 5, nor “*after said cutting said wafer, irradiating a surface of said plurality of wafer chips with ultraviolet rays to thereby clean said group III nitride compound semiconductor device*” as recited in claim 8.

As noted above, unlike conventional methods of manufacturing a group III nitride compound semiconductor device, the claimed invention (as recited in claim 1) irradiates a surface of the semiconductor device with ultraviolet (UV) rays after patterning a resist layer, to clean the semiconductor device (Application at page 4, lines 7-9; Figure 2). Unlike the conventional methods, in the claimed method, the UV rays effectively clean the surface without damaging the wafer (Application at page 4, lines 10-13).

In addition, the claimed method (e.g., as recited in claim 8) may include irradiating the surface of a plurality of wafer chips after cutting the wafer. This feature is important for ensuring that the surface of the wafer is free of contaminants, such as an organic resist residue, after cutting the wafer.

Clearly, these features are not taught or suggested by Yamazaki. Indeed, as noted above, Yamazaki is merely directed to removing oxides and dirt from a semiconductor surface (Yamazaki at col. 7, lines 10-67). That is, like Kern, nowhere does Yamazaki teach or suggest a patterned resist layer, let alone irradiating a surface of a wafer after a resist layer has been patterned.

Further, with respect to claim 4, the Examiner concedes that Yamazaki does not teach or suggest each and every element of the claimed invention, but alleges that Kern makes up for the deficiencies of Yamazaki. Applicant submits, however, that these references would not have been combined and, even if combined the combination would not teach or suggest each and every element of the claimed invention.

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems and solutions. Specifically, Yamazaki is directed to a method of removing oxide formations from a surface, whereas Kern is directed to depolymerization of polymers on a surface. Therefore, these references are completely unrelated, and no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner merely states that it would have been obvious to combine these references in order to remove impurities from p-type semiconductor layers. However, the Examiner's stated motivation to combine is completely unrelated to irradiating a surface of a wafer after patterning a resist layer and, therefore, is insufficient to support the alleged combination.

Moreover, Applicant submits that neither Yamazaki, nor Kern, nor any combination thereof teaches or suggests "*wherein said irradiating said surface of said wafer is performed after said patterning said resist layer*" as recited in claim 1. Indeed, as noted above, nowhere does Kern disclose a patterned resist layer, let alone irradiating a surface of a wafer after a resist layer has been patterned. Therefore, Kern clearly does not make up for the deficiencies of Yamazaki.

Therefore, Applicant submits that there are elements of the claimed invention that are not taught or suggest by Yamazaki, and that Yamazaki would not have been combined with Kern and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Therefore, Applicant respectfully request that the Examiner withdraw this rejection.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-20, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed

Serial No. 09/935,699
Docket No. T36-135964M/KOH

11

below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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